AMRAD NEWSLETTER

Amateur Radio Research and Development Corporation

May 1982

OUR MAY 5 MEETING in Vienna, VA will take up the subject of packet radio protocols. Contributing to the discussion will be Terry Fox, WB4JFI; Dave Borden, K8MMO; and Paul Rinaldo, W4RI. As always, visitors are welcome. The meeting will start at 7:30 P.M. in the Patrick Henry Branch Library, 101 Maple Avenue East (Virginia Rte 123).

THE NEXT REGULAR VIENNA MEETING will be on June 7. Each year AMRAD sends judges to several Northern Virginia high school science fairs to select students who have outstanding projects relating to amateur radio and personal computing. This program is managed for us by AMRAD Director Dr. William Pala, Jr. Winners of the AMRAD awards have been invited to demonstrate their projects at the June 7 meeting. This is meant to be a family affair, so please invite your teenagers and their friends to this fascinating show and tell.

LONG ISLAND TECHNICAL TALKS were first aired over AMRAD's WD4IWG/R 147.81/21 McLean, VA repeater on April 14. We didn't make arrangements in time to announce it in the last issue of the AMRAD Newsletter. However, it will be a regular feature on the second Wednesday of each month at 8:30 P.M. Those of you who caught the April 14 transmission noticed that the audio quality was not what it should have been. AMRAD Director and repeater trustee, Jeff Brennan, WB4WLW is working on the problem. We owe thanks to Dave Gerrish, W4VA for his help with facilities at the McLean end and to Charlie Kosman, WB2NQV in New Jersey. These talks are sponsored by the Long Island Amateur Radio Club and the LI chapter of the IEEE. The next session is scheduled for May 12. For more information, contact Ed Piller, W2KPQ at 516-349-2484 (work) or 516-938-5661 (home).

SOME REPEATER LINKING EXPERIMENTS between Northern Virginia and New Jersey are planned for Sunday evening, April 18, which is old news by the time that you read this. However, a land-line patch is being set up to permit packet radio discussions between the two clusters of packeteers who are able to work into either repeater. The success of the April 18 patch will determine whether to do it on a regular basis and how to make it work best for the participants.

Plans are afoot to set up an interim 220-MHz packet radio backbone network running up and down the East Coast of the United States and Canada. The New Jersey and Washington, DC area groups are key to making this work. People, equipment and sites have been tentatively identified along the way except for some large gaps in the vicinities of Fredericksburg, VA; Baltimore, MD; and Wilmington, DE. Ideas?

We have heard from Dave Sarault, WA1DWE that he and the ECARA group in Eastern Connecticut have agreed to provide packet radio repeater facilities to link the Newington, CT and Boston, MA areas.

Individuals or groups up and down the East Coast who may be interested in setting 220-MHz packet repeaters are invited to contact Paul Rinaldo, W4RI, 1524 Springvale Avenue, McLean, VA 22101, phone 703-356-8918 days or evenings.

GREETINGS TO DAYTON HAMVENTION ATTENDEES from AMRAD. We are a technically oriented world-wide club of over 500 radio and computer amateurs. As our name suggests, we are interested in amateur research and development projects of a wide variety. Here are some of our active projects:

Packet Radio is our biggest project now, as can be seen from this issue of the AMRAD Newsletter. We regularly carry Dave Borden's "Protocol" column and have done so since February 1980. This year saw the introduction of the "Tucson Amateur Packet Radio Activities" column written by Den Connors, KD2S; Lyle Johnson, WA7GXD; and Chuck Green, NOADI.

Dave Borden also writes a regular "Data Communications" column for QEX - The ARRL Experimenter's Exchange. If you want to get into packet radio, the AMRAD Newsletter and QEX are important sources of information.

For a quick tour of packet radio, see "The Making of an Amateur Packet-Radio Network," by K8MMO and W4RI, QST, October 1981. Reprints of this article are available from AMRAD. Please send a business-size s.a.s.e. (20 cents postage) to 1524 Springvale Avenue, McLean, VA 22101.

Spread Spectrum experimentation is also one of our major projects. Hal Feinstein's "Spread Spectrum" column appears in this newsletter. We just completed a one-year Special Temporary Authority from the FCC to conduct on-the-air spread spectrum tests. We are now in the process of preparing our year-end report and plan to ask the FCC for another STA in the near future. If you're interested in joining us in this effort, please contact Hal as soon as possible and describe the experiments that you can contribute.

Telecommunications for the handicapped is an ongoing project. We completed a two-year project which was sponsored by the U.S. Department of Education to apply personal computers to the communications needs of the handicapped. Part of the project was the development of software/hardware interfaces between popular personal computers and teletypewriters (TTYs) used by the deaf. We also operate a special computerized bulletin board, called HEX (Handicapped Educational Exchange), which you can reach by dialing 301-593-7033. It's a free service which lists information relating to education of, and communications with, the handicapped. You can access it with either a 300-baud Bell 103 computer terminal or a TDD (deaf TTY). As you read this, system operator, Dick Barth, W3HWN is in the process of bringing up the new HEX -- with hard disk and many new features.

That's a sampling of our main activities. We are interested in broadening our base into new and challenging technical areas. We are always interested in new members. Will you join us?

Interim Specs for AMICON (the AMSAT International Computer Network) are now being written by Hank Magnuski, KA6M, with an early May target date, for use on Oscar Phase III-B which should be launched this fall. AMRAD is now preparing its recommendations.

SPREAD SPECTRUM

Hal Feinstein, WD3KDU
1410 Rhodes St. North
Arlington, VA 22209
703-524-9116 home

A Second Look at Spread Spectrum

Spread spectrum (SS) is a communication technique which uses wideband modulation that may exceed the bandwidth of the information by more than ten times. In fact it is not uncommon the find as much as 10 MHz bandwidth to transmit 3 kHz of information.

Because of a property of invisibility under certain situations, it has been used by the military for signal hiding. SS cannot be properly received on a general ham radio receiver but needs special types of receivers to decode the SS transmissions. To decode an SS signal, the receiver needs a copy of the original coding sequence. This leads to many interesting properties which are currently being considered by both government and industry.

We have finished the first year of a testing cycle on SS modulation techniques. The year saw the FCC granting AMRAD a Special Temporary Authority (STA) which allowed us to experiment with SS - a mode which was not legal under normal rules of the Amateur Radio Service. We have conducted several interesting experiments with SS using both gear developed for the military and homebrew rigs built by STA participants.

One of the big objectives of SS has been to domesticate it. It was developed for the military and has all the trappings, insights and jargon that one expects to find attached to military programs. There were several things that needed investigation. For example, a major concern was self policing by amateurs. Within AMRAD there have been some discussions which resulted in ideas on the self policing and enforcement aspects of SS. We came up with a concept for a new type of receiving system, one which did not need to know the code sequence in order to receive a frequency hopping signal.

We discovered that there are numerous codes which are complex yet do not have privacy properties. So, the number of codes that amateurs could use is larger than originally thought. In case a station illegally uses a complex code to hide the meaning, there are some workable concepts which could be used to detect this.

TVI problems have not been encountered in our tests. However, some people seem to be concerned about it and had the idea that SS-generated TVI would be hard to identify. Study has shown that TVI complaints can be resolved in much the same way that normal TVI complaints are handled. So far, we haven't seen any practical results to indicate that SS is any worse a source of TVI than anything else.

All that AMRAD found out about SS in the first year was not totally favorable. The biggest unresolved problem is the near/far effect. In the near area, the SS signal is higher than the noise and is spread across a band. However, the signal strength falls below the noise some distance away. A rough bottom line is that SS is can be worse in the near area and better in the far area than people usually imagine. We are not certain what can be done in the near area but are looking for approaches.

SS is an interesting technique and should be experimented with by amateurs. We feel that these experiments can be done in the amateur bands without undue interference with other users, including moonbounce and other weak-signal communicators. Hopping patterns and rf filtering can be used to protect the weak-signal listeners.

The FCC and commercial interests are looking to SS as a way of packing more signals into a given band. Hams look at it as a context for experimentation and innovation, not a routine operational mode.

AMRAD Files Reply Comments to FCC

On April 15, AMRAD filed its reply to the comments made by others to the FCC in response to the FCC's Gen. Docket 81-414. The docket proposed to make SS a legal emission under the FCC Rules. In it, the Commission proposed several restrictions on types of codes and classes of amateur licenses eligible to use SS.

In general, the comments on file appealed to the Commission to go slow. But, there was a general feeling that amateur experimentation with SS should be allowed provided that certain interests were protects. One of the more interesting suggestions was that the FCC consider a two-year test period after which the Rules would be reviewed.

Our comments were in favor of going ahead with the proposed Rules for SS and leave the protection of the special interests, such as weak signal subbands, to be worked out within the amateur community.

New Experiment Proposed for the Next STA

Chuck Phillips, N4EZV has told us that he wants to experiment in the 14- and 21-MHz bands with frequency hopping. The hopping speed is up to 80 hops per second. The hf equipment will be based on Chuck's 2-meter hoppers that he demonstrated at the February AMRAD meeting in Vienna, VA. Chuck has already lined up experimenters on the East and West coasts. He is writing up the STA test proposal for inclusion with the others. Meanwhile, if you have a specific SS test proposal, please mail it to me as soon as possible for inclusion in the new STA request. The new request will not be submitted until we finish writing the results of the first year's experiments, which should be done soon.

ISO Network Architecture

Terry Fox, WB4JFI
1819 Anderson Road
Falls Church, VA 22043
703-356-8334

This month I will discuss the ISO network architecture and how it can apply to Amateur Radio packet networking. It seems that a lot of us are trying to add features to packet radio that would be very beneficial. Unfortunately, some of these features are being added at the wrong level of the system, which can cause problems in implementation and operation later on down the road. Rather than kludging things up, I suggest we research very carefully what has been done so far by the computer network industry. They have spent many years learning about this subject, both in theory and in practical application. To reject them out of hand as not applicable to amateur packeting without really studying them is a major mistake most of us are making, and we WILL regret it sooner or later. A combination of standards used by the computer industry could well serve as a good base to build our packet radio networks on.

What follows is how the International Standards Orginization (ISO) has broken the network design problem down into smaller, manageable tasks. Each layer has a separate task or function from the layer above or below. These seven layers are as follows:

7. Application Layer (highest level)
6. Presentation Layer
5. Session Layer
4. Transport Layer
3. Network Layer
2. Link Layer
1. Physical layer (lowest level)

These layers are described further below, along with what standard I think we should consider using at that level. What we should be primarily considering at the moment is levels 1 to 4, which together make up the complete end-to-end protocol to make sure data will get from point A to point B (i.e., Washington, DC to San Francisco) accurately. Levels 5 to 7 have more to do with what the data is, how to use it, and where to put it.

Layer 1, Physical Layer

The physical layer has to do with what voltage levels are used, at what speed, and in what order. In packet radio we have added modems and radios on this layer. Usually you will see RS-232-C as the standard recommended to use. This layer is responsible for getting the actual zero's and one's from the sender to the receiver accurately, hence the name physical layer. This is the only layer in which there usually exists an actual physical connection at the two ends. The layers above maintain a logical connection between the sender and receiver, usually by adding some information to the data that the receiver(s) can interpret. It is important to note that this is the only layer in which we amateurs are actually unique. Since we have several, quite different transmission media that we could use, our situation is different from most of the computer industry. Even Aloha, the University of Hawaii packet radio experimental network, doesn't take into account all the variations and problems we amateurs are faced with at the physical layer.

For now, most of us are using Bell 202 type modems on 2 meters with a terminal node controller driving the modem with RS-232-C. Sooner or later we will have to start serious work on other physical layers, such as satellite, vhf/uhf high-speed backbone, and hf operation.

Layer 2, Link Layer

The link layer is the layer responsible for taking the data from the higher levels, creating small groups of data, called packets, and sending them accurately across the supplied physical layer. In order to assure that each packet, or frame, crosses the physical layer properly, the link layer usually adds some information of its own both before and after the actual data given it from the above layer. Each packet is usually numbered, with that number added before the data. The receiving station can compare this number to what it is expecting as the next packet number, and if they don't match it knows something is wrong.

In order to assure the data received is the same as the data sent, some form of error-detecting character is usually added to the end of the data stream. This is generally a number calculated by doing some mathematical computation on the packet. When the receiver gets a packet, it goes thru the same computation, and if its number doesn't match the one the sender sent, the receiver assumes that the data has been corrupted.

In addition, most link-level procedures have reserved a portion of the packet for sending supervisory information back and forth along the link layer. Keep in mind that the link layer maintains a virtual, not actual electrical, circuit between the two sides. The physical layer can have electrical signals in parallel to the data connection that for example tell the sender when the receiver cannot receive any more data. The link layer does not have these seperate connections available to it, so it imbeds this type of information in another part of each packet it sends or receives, called the control field. This control field usually has the counters mentioned above to keep the sender and receiver in sync on the packet numbers. In addition there is a form of flow control. The receiver can tell the sender it is full, and cannot receive anymore data for the moment. This control field also has other portions that are responsible for establishing, maintaining, and disconnecting the logical connection between the two devices. An address field is usually implemented to make sure that the link is talking to the other link level device it has connected to, and not some other device that may share the same physical layer (such as several hams on the same 2-meter frequency).

In the opinion of most network designers, and I agree, this is not the place for other functions, such as device selection within each user, multi-user hookups, or how to route the data thru the system. It has enough to do just maintaining the data link reliably between two points. The above functions are for the higher layers. Therefore, I reccommend we use a version of HDLC called ADCCP. This is very similar to what we are using on the air in most of the country with the VADCG TNC board. I would like to point out my addressing scheme in the AMRAD Newsletter two months ago that would allow fixed addresses for each ham without a lot of added hassle.

Layer 3, Network Layer

The network layer has often been divided into two sublayers, called the network sublayer, and the internet sublayer. The first is responsible for maintaining control over a group of links, while the internet layer is used to send data back and forth between these individual networks.

Network Sublayer

The network sublayer (called by NBS layer 3A) is responsible for maintaining the individual link connections from the link layer, and it is also responsible for routing the data from the sender to the proper receiver(s). Since there can be several link level connections going on at once, there is the potential of overloading the network with data. A system similar to level 2's flow control is used at the network level to make sure the network doesn't get overloaded.

The network layer is also where group connections can be made.

→

Digitized by the Internet Archive
in 2025 with funding from
Amateur Radio Digital Communications, Grant 151

https://archive.org/details/amradnews1982-05

Internet Sublayer

The internet sublayer (called layer 3B) is used to connect the individual networks together so data from an individual on one network can be sent to someone else on a different network. This layer is NOT used instead of the network layer, but rather in addition to the network layer. It creates its own headers, and has separate information from the network sublayer. It appears that this layer was originally overlooked, and got added to the network layer as it became obvious it was needed.

The internet sublayer usually creates its own header. Some of the information found in this header will be the origination and destination addresses of the data, and what part of the data this is, in case the data is broken into several parts to allow it to traverse a limited size network along the way. Sometimes bits signifying speed or reliability are added to the header, in case the data is urgently needed, or to signify that some of the data can be lost (i.e., digitized voice).

There are two approaches to the network and internet sublayers. One is called the virtual call circuit, and the other is called datagram service. A brief discussion of each follows.

Virtual Call Circuits

The virtual call circuit is a system in which the network (or internet) layer establishes a particular logical connection between the source and destination devices, assigns a number to that logical link, and then uses that same logical connection throughout the length of the connection. This has the advantage of not having to recalculate how to send a packet from point A to point B each time that it recieves one. This means there is much less overhead after the initial connection process. The major drawback to this system is that if something goes wrong, such as the network controller going down, all connections are lost, and everything must start from ground zero. An example of this type of system is the level 3 portion of X.25.

Datagram Service

A datagram generally consists of the data to be sent with a larger header tacked on than required by the virtual circuit. Basically, its advantages and disadvantages are just opposite to those of the virtual circuit. In a datagram, each header has the source and destination address, as opposed to a virtual circuit number. This means that the network must make routing decisions on each datagram, which can significantly increase the time a datagram is in the network. However, if part of the network goes down, the datagram system can recover much easier, since the routing can be changed, and the whole addresses are known, rather than a now useless circuit number. An example of datagram service at the network sublayer is ARPANET.

After a lot of research, and talking to several people in the networking field, I would strongly reccommend that the amateur packet community use the X.25 virtual circuit standard at the netork sublayer of layer 3, and the NBS internet standard (datagram) for internetwork use at level 3. Usually the individual networks will be reliable enough to support a virtual circuit system, while using datagram service between networks will allow dynamic routing of data between networks. There will be more discussion on these protocols in the coming months.

Layer 4, Transport Layer

The transport layer is the last layer that is responsible for getting the data from one end of a network (or group of networks) reliably to the other. This is sometimes called end-to-end level. The lower levels are used to talk to their equivalents thru the network, and data may have gone thru several layer 3 systems before arriving at the destination. The destination layer 3 protocol is responsible for receiving the data from the network, and giving it to the transport layer. The transport layer then checks the data, puts it in proper order if it came in wrong, and usually sends an acknowledgment message back to the originating transport layer. This is the first time that the sender gets a message from the destination system saying that the data actually got thru the system intact. The receiving transport layer then determines which session layer the data belongs to, and sends it there.

The transport layer is where the determination is made as to which device data should go to, such as a printer vs. terminal.

The recommended transport layer is a subset of the NBS Transport layer. More on how this layer works in the future.

Layer 5, Session Layer

Some computer systems can run several different programs at once, such as having one user play Star Trek while another user is assembling some new packet software. Also, some computers will allow several different users run a common program, such as several callers into a bulletin board system. Each of these processes is called a session, and requires a separate connection to the layers below. The session layer determines how the data received from the transport layer is to be processed. It also makes sure that the session is handled smoothly. An example of this is if someone is on a bulletin board sending a message, and for some reason he disappears. The session layer must inform the program that he is gone so the bulletin board doesn't end up half way thru a process. It must also disconnect from the bulletin board in an orderly manner, and tell the layers below to disconnect if they haven't already.

Obviously, not all systems need a complicated session layer, and many applications may not require one at all. If it is required, though, it looks kile the NBS Session Layer may be the way to go. It is too early to tell for sure, and a standard is not really essential at this time, since we are still trying to get bits from here to there accurately.

Layer 6, Presentation Layer

The presentation layer has mainly to do with how the data can be displayed on the screen, and any code conversion or data compression used. Quite often it can be a null layer.

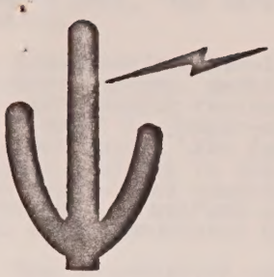
Layer 7, Application Layer

This layer is totally up to the individual user. It has to do with how a program is run, and what the program expects to see. Obviously, some agreement must be made between the two ends at this level otherwise the user won't know what the program wants to see. Some initial work has been done at this level, such as trying to standardize file transfer programs and message handling programs, but it is still basically open season.

Well, that is a basic overview of the typical network architecture and how responsibilities are divided up. I think it would be foolish in the long run to kludge the various levels or portions of them around to make quick fixes. Sooner or later it WILL come back to haunt us. The people that have come up with this scheme have spent one heck of lot more time and money coming up with this system than we have, and while I often feel like most amateurs do about being David out to slay the Goliath's of the communication industry, I also size up Goliath first. In this case, he has done his homework correctly, and I think we should follow his footsteps as much as possible. □

Jobs for Radio Systems Engineers (30-40k), Telephone Systems Enginners (30-40k) (both 3-5 years experience), Communications Engineering and Planning Manager (45-55k) (7-10 years experience), and Junior Engineers (25-30k) (0-2 years experience) are available from Robert Heller Associates. Contact John Hart, 25 Valley Dr, Greenwich, CT 06830, 203-869-1666.

Proceedings of the ARRL-sponsored packet conference in October 1981 are no longer available at the original deal of $5 for set of two printed volumes. However, photocopy reproductions can be obtained from AMRAD for the cost of reproduction plus mailing which amounts to $8.00 per set. Send check payable to AMRAD to 1524 Springvale Avenue, McLean, VA 22101.



Tucson Amateur Packet Radio Activities

Den Connors, KD2S
4708 West Wild Horse Drive
Tucson, AZ 85741

By the time you read this, Tucson will be on the air with packets from a new amateur packet radio terminal node controller (TNC)!

Lyle Johnson's report contains information on the status of our hardware, and as of this writing (April 6), the pc boards and parts are all here, and we will be having a grand time building the first dozen "alpha test level" boards. For those who have been patiently awaiting the beta tests, we have nothing in our way but potential hardware and software problems!

Chuck Green's part of this column is a response to the proposed addressing scheme of Terry Fox, WB4JFI. Dynamic addressing offers a number of advantages to routing. Considerable efficiencies may be possible with our scheme, which will not be noticeable when using the current hardware schemes of having an actual Bell 202 modem attached to a TNC, with its slow channel turnaround time, but which will be increasingly important as TAPR-like boards (with on-board modems capable of turning the channel around as quickly as the transceiver can switch modes) find wide acceptance.

Mike Parker, KC7GD has volunteered to become chairman of our L-band transmitter project, designed to create inexpensive up links to the soon-to-be-launched AMSAT phase III-B satellite. We have been working with AMSAT on an integrated unit, with assistance from the Electrical Engineering Department at the University of Arizona. Expect to see some prototypes later this summer.

Our software efforts are now keyed into two separate projects. Marc Chamberlin, WA7PXW is writing the high-level FORTH routines to create the functions of terminal station, net control station and digipeater in each terminal node controller board. Dave McClain, N7AIG, our inventer of Subroutine Threaded Code FORTH and the FORTH target compiler for 6502 machine code, is working on integrating the primitives for hardware control into commands which are accessible to the higher-level words. A promised explanation of how our software is configured will wait until our alpha tests are completed.

In addition to this initial installation of TAPR dynamic-addressing protocol onto the TNC, Margaret Sandel, KC7MA and myself will be using the FORTH definitions written by Marc and Dave to build the on-board Vancouver protocol emulator. With the availability of up to 16k of PROM, we should have little problem creating both the VADCG station and repeater protocols. It is presumed that the repeater protocol used will be the AMRAD/K8MMO scheme. At board configuration time (anytime you wish to change the nonvolatile RAM with the TNC configuration parameters), the user will decide whether he wishes to be a Vancouver or Tucson TNC, and whether he desires to be a user station, digipeater or, in the Tucson case, a net-control station.

TAPR Hardware Report by Lyle Johnson, WA7GXD

The TAPR TNC Project is gathering momentum at an alarming rate! By the time this column appears in print, experimental packets should be traversing the arid ether of Southern Arizona between the dozen alpha test sites.

As of this date (23 March 82) the PC fab facility has promised the alpha board delivery on or before 2 April 82. All parts except 1 IC and 2 resistor values are in hand or in transit. N7AIG's Meta-Forth target-compiling system has been exercised (by generating a fast STC Forth system for a Rockwell AIM 65 computer) and found to work exceedingly well. WA7PXW's TNC simulation software is up and running with most TIP/LIP modules now having been written and run on the simulator. WA7GXD's self-test and modem-calibration routines are being run on the AIM 65. The TAPR gang is ready to tackle alpha test.

It thus appears that alpha test will commence during the week of April 4th and continue until TAPR is confident that the system is working - and working well. At that point, beta test will begin. Please see last month's column for details on beta test participation and procedures.

TAPR has been holding discussions with the New Jersey groups on a regular basis to try to find a common method of approach at the system level for the next logical project in the packet revolution - a moderate-speed uhf linking system. Design goals for both hardware and software include easy maintainability, high reliability, low cost, use of readily available components, and so forth. Comments, anyone?

Now for this month's highlight on the TAPR TNC - the transceiver interface.

The essential elements for this interface include transmit/receive control, microphone-audio level afsk input.

Transmit/receive control is effected via a simulated contact closure to ground to activate the transceiver T/R switching circuitry. The primary problems faced in this design relate to the myriad radio systems in general use on the Amateur Radio bands. The TAPR TNC solves this problem by providing a spike-protected NPN switch to shunt a nominal +12-volt 500-mA line to ground. This should handle most radios. While a mercury-wetted relay would have been more universal, the cost of such a component was considered to be too high in relation to the overall cost of the TAPR TNC. If the user is interfacing to a non-compatible radio, a generous wire-wrap area has been provided for whatever customization may be necessary.

Further, the T/R control line is protected from locking up (power glitch causing the microprocessor to hang in the transmit mode, for example) by a 555-based watchdog timer. This limits the maximum transmission period to several seconds, changeable by a simple resistor swap.

Microphone-level afsk audio output is provided by buffering the output from the XR-2206 afsk generator with an op-amp section, which is then capacitor-coupled to the output pin on the transceiver interface connector. A 15-turn trimpot is provided to set the level from this circuit. Typical range is from a few millivolts to 3 volts peak-to-peak. The output waveform is a sine wave with less than 5% distortion. The op-amp buffer provides a very low source impedance, capable of driving most commonly used microphone amplifiers. If it doesn't match a particular

user's unit, the wire-wrap area will prove to be useful.

Headphone/speaker-level audio input is sent to another op-amp section used as a limiter. A speaker-loading resistor of 10 ohms (careful, only 1/4 watt) is jumper-selectable by the user. The clipper uses LEDs for level setting, offering visual feedback to the user for proper setting of the audio-level control on the transceiver. This provides a uniform audio level into the XR-2211 PLL afsk demodulator for higher data integrity.

The transceiver connector is a 10-pin header, consisting of 2 rows of 0.025-in. square posts on 0.1-in. centers. This allows for wire-wrap or header connectors. Other functions brought out on this connector include HDLC I/O and modem-to-HDLC nodes. The purpose of this is to encourage experimentation by making the WD1933B chip I/O available for connection to other modems (hf-optimized, higher speed, etc.) as well as making the modem available for other uses (cassette tape I/O, acoustical couplers, and so on). Necessary interconnect changes between the 1933 chip and the modem circuitry may be conveniently done via the push-on style jumpers provided on the board.

As a result of findings during alpha and beta testing, the documentation with the TAPR TNC will include interfacing instructions for all rigs that have been utilized prior to the documentation publication date. General information for non-specified equipment will also be provided.

Next month we'll focus on the uP side of the TNC design.

Meanwhile, if you have any comments, suggestions, or ideas regarding anything mentioned in this column, please contact us. And spread the word about packet radio. - Lyle Johnson, WA7GXD.

Protocol by Chuck Green, NOADI

I was very interested in the article by Terry Fox, WB4JFI in the March issue of the AMRAD Newsletter. I have been working with the TAPR group on protocol, and it is interesting to see that Terry has considered many of the same problems that we encountered while developing our protocol. There are several things in Terry's proposal that I would like to address.

His discussion on the use of the 8-bit address byte was a "bit" puzzling. If one bit is used to indicate that a station wants to be repeated through a digital repeater and another bit is used to indicate that this packet has been repeated, this does not leave 6 bits in an HDLC address field. As is pointed out later in this article, bit 0 is reserved to indicate whether this is the last 8-bit address field. This leaves 5 bits for actual addresses (maximum of 32 unique addresses). This could be a bit limiting, even for a system using dynamic address allocation.

Actually, it is not necessary that a station receiving a packet know if the packet came from a digipeater or not. It is necessary only that the station know whether to acknowledge the packet, wherever it came from. Indicating to a digipeater that it should repeat a packet and letting the destination station which can copy both the original packet and the repated packet know which to respond to can be done with one bit.

The originating station turns the bit on if it wants the packet to go through the digipeater. If the digipeater sees a packet come along with that bit on, it turns the bit off and retransmits the packet. The destination station when seeing the original packet will ignore it because the "repeat" bit is on. When the destination station sees a packet with its address and the "repeat" bit off, it responds to this packet positively without knowing or caring whether it came through the digipeater or directly from the originating station.

There is also no reason why this "repeat" bit should be in the address field. By putting it in the control field (it is a control bit, isn't it?) we can end up with 7 bits available to make up to 128 addresses.

This is exactly what we have done in the TAPR protocol. Yes, there is more to it than this; a system of positive acknowledgements and busy signaling is also involved.

The number 126 (128 minus 2, X'01' and X'FF') would seem to be more than adequate for a single local-area network with a finite throughput capability. It seems adequate even to provide some extra addresses for sub-nets (nets in traditional hf language), special addresses for links to other local-area nets, multiple addresses for the station finding itself in the rf domains of more than one network control station on the same frequency, etc.

We have also decided that the origination station address should be in the HDLC frame. This involves a second 8-bit address field. These two address bytes are considerably fewer than the fourteen that could be required to accomplish the same thing using Terry's proposal. When it comes to inter-local-area-network packets, however, I must fully agree with Terry; it is time to start sending the ultimate unique identifier (I hope), our call signs.

The problem of stations going away to another frequency and taking their addresses with them then coming back to the original frequency only to find their addresses reassigned to someone else can be greatly reduced by making this unnecessary. This is one by providing all stations with the logic necessary to be a local-area-network-control station. Stations wishing to go to a frequency by themselves can just go form their own (mini?) local-area network.

The problem can also be reduced by establishing a policy of always logging into a local-area network when you come on frequency. If you are already logged in, the network-control station can simply reassign your old address to you.

There is still the possibility of a problem here which must be dealt with. Careless operating practices could still result in more than one station with the same address, although it could occur only in a heavily loaded network. In most cases, however, the network-control station would detect the situation, force one station to log out and back in, and no one would even notice (including the stations involved).

It is also a good idea for all stations to be able to be the network-control station to provide maximum availability. You wouldn't want to be dependent on one station or even a subset of stations to establish a local-area network.

This is all included in the TAPR protocol.

As I hinted earlier, there is a solution to the problem of a station located in the overlapping rf domains of two (or more) local-area-network-control stations on the same frequency. This is done by assigning additional addresses to the station involved (one for each network) and marking all but one (different one in each network) to be ignored. This will make the station a member of each local-area network. The station could also act as a link between each of the networks involved, but that is a different subject.

There is quite a bit involved in establishing this configuration (discovering that you are in this situation, who got there first, etc.), however, it seems worth the programming effort.

There is also a performance consideration to be thought about. The probability of a station in this situation successfully sending or receiving a packet is the product of the probabilities of success in each of the individual networks. This final probability may be altered somewhat by the capture effect of fm radio.

Yes, this will be implemented in the TAPR protocol.

I like Terry's idea of sending digital call signs instead of cw. To have to slow down to 20 wpm to i-d is somewhat perplexing to say the least. It is for the same reason (efficiency) that I don't like sending entire call signs in each packet when it is not necessary.

I would also like to see the FCC change its i-d requirements. However, altering the ten-minute requirement really isn't what is needed. What is needed is dropping of the 20-wpm cw requirement. If this were done, we could include our call signs in a packet once every ten minutes to satisfy the i-d requirements without slowing down. →

THE DEAF AND THE TTY

Barry Strassler
Executive Director
Telecommunications for the Deaf, Inc.
814 Thayer Avenue
Silver Spring, Maryland 20910
301-589-3006

Views of a Dissident Viewer

One deaf person that I know in professional circles has lambasted the use of decoders in Line 21 captioning. I do not agree with him, but at least I am stating his views for your perusal.

Here is an inkling of his comments:

"Decoders are expensive. Many of us spend around $500 for a TV and to add another $250 is not easy.

"How would hearing people like it if they purchased a TV for $500, but without sound? And for $250 extra, sound is added to it.

"If we have two television sets at home; one upstairs and one downstairs, with only one decoder, we would have to transport it back and forth in order to watch captioned programs on either set.

"Not all programs are captioned, so why pay $250 for only a few programs?

"When I first bought my decoder, I ran home and set it up to see if it worked. But I had to wait two days to find out since there were no captioned programs at that time. It should be the other way around - all programs must be captioned first then the people will buy. They can't promise captioning in hopes of getting the deaf to buy the decoders first."

This dissident might be right, but my disagreement is a matter of attitude. There are some people who feel that because they are disabled they deserve to receive things without paying for them. This creates inbred sympathy for one's own plight, and to me, it is a negative approach to life.

Closed captioning is a boon to the deaf, perhaps the next-to-the-best piece of technology that came our way (the TTY was the first), and if we don't support it without purchases, then future technological innovations would pass us by.

TAPR (continued from previous page)

I disagree with Terry's conclusion that the "disadvantages to using this system all seem to add up to increased overhead for the controlling processor" (referring to his extended-address proposal). The real disadvantage is in the increased overhead on the frequency. The controlling processor probably doesn't have much else to do at that time anyway.

Even when using a one-byte address which the HDLC chip could recognize, you probably would not be satisfied with the limitation of only being able to monitor one address (plus X'FF', broadcast). There are several reasons why you might want to monitor more than one address (sub-net participation, multiple local-area networks on the same frequency, linking stations, curiosity, etc.).

It would seem that most of the advantages available in Terry's extended-address proposal are included in our dynamic-address-allocation system. In any event, it will not be necessary to just speculate much longer. Although we will never consider the TAPR protocol "cast in stone," the time has come that we must implement something, and we have chosen dynamic-address allocation.

A nice thing about microprocessor-based terminal-node controllers is that protocol can be easily changed. If our protocol has come major difficulties or even if another protocol just proves to be better, I will be the first one to suggest a change.

I am really glad to see articles like Terry's and others. They make us all think! I hope that someone will implement his proposal so that direct comparisons can be made. I know that some would have us all use one protocol, and there are some major advantages to this (compatibility). I think that the advantages of experimentation in the search for an "ultimate protocol" outweigh other considerations. 73s - Chuck Green, NOADI, 3053 N. Longhorn, Tucson, AZ 85715.

Next month we'll present an article describing the levels of protocol being used in the TAPR scheme, including the physical and data link functions, as well as level "3A," the network-control level and interface to Internet Protocol (level 3B) and higher layers. 73s from TAPR.

Back issues of the AMRAD Newsletter are available at the cost of $1.00 per issue

James Martin has written a new book entitled "Computer Networks and Distributed Processing, Software, Techniques, and Architecture." It should prove to be a useful reference for amateur packet radio enthusiasts who are trying to get themselves up to speed on computer networking. It's available from Prentice-Hall for about $34.

Radio Shack has a Time Manager program for its Model I and Model III computers at a cost of $99.95 at their stores. It organizes daily schedules, keeps expense and mileage records, and performs other user-difined tasks.

George Washington University is offering Course No. 699 in Synchronization in Spread Spectrum Systems, July 12-15, 1982 in Washington, DC. Call 800-424-9773 or 202-676-6106.

PROTOCOL

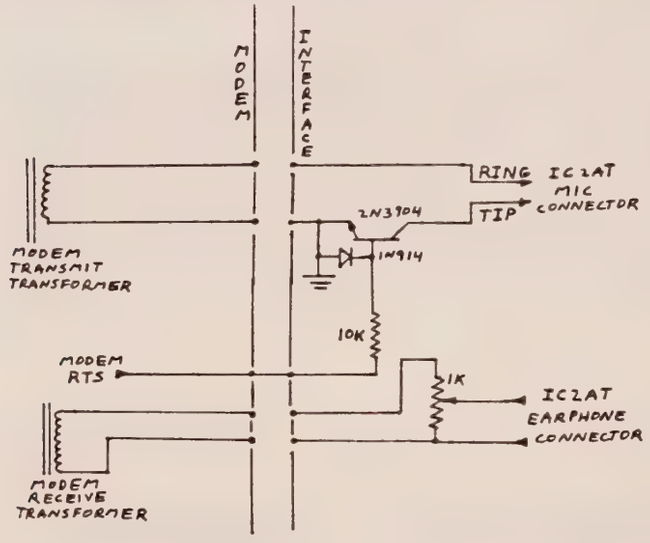
Normally conducted by:
David W. Borden, K8MMO
Rte 2, Box 233B
Sterling, VA 22170
703-450-5284

This month's guest ghost:
Terry Fox, WB4JFI
1819 Anderson Road
Falls Church, VA 22043
703-356-8334

Well, this month we find Dave frolicking around the world, so I have come up with a column. I will discuss interfacing modems to rigs, and answer some questions regarding my addressing scheme described in the March 1982 AMRAD Newsletter.

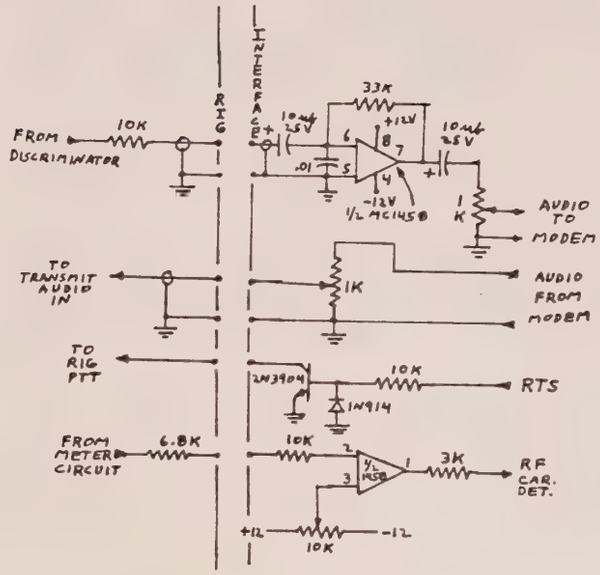
Interfacing

There are many types of radios that amateurs are using for packeting. Some of these radios are very easy to hook to modems and TNC boards, while others can be difficult. One of the more popular radios on 2 meters these days is the ICOM IC-2AT hand held. While this radio usually won't be used as a base station, it can be used nicely as the radio portion of a packet radio station during demonstrations. AMRAD has used the IC-2AT when showing off packet radio during hamfests and at talks to other clubs. The interface between this radio and the modem is very simple, as shown in Fig. 1. The RTS signal from the TNC is routed thru the modem. There it is picked off, changed from RS-232-C levels, and used to drive the transistor on. The transistor shorts the tip of the IC-2AT's microphone connector to ground, turning on the rig's PTT. The audio is fed from the modem to the IC-2AT thru the modem transmit transformer. Receive audio from the IC-2AT is coupled to the modem thru the level control.



ICOM IC-2AT INTERFACE
FIGURE 1.

The circuit shown in Fig. 2 is what I ended up using on my Kenwood TR-7400. The Kenwood has a lot of de-emphasis in its audio circuitry. I found that if I scoped the audio output and had someone send me mark and space tones, the 2200-Hz tone was almost nonexistent. While most modems have some sort of level control, the output of the 7400 wasn't going to cut it. After opening up the rig and looking at various points inside it, I soon realized the only place that the audio levels



KENWOOD 7400 INTERFACE
FIGURE 2.

were remotely acceptable was right at the output of the discriminator. I put a 10k resistor in the rig to buffer its output before sending it to the outside world. The receive audio then goes thru an op amp for buffering and then thru a level pot before it is sent to the modem. The modem transmit audio is sent thru a level pot and sent to the 7400 transmit audio input. RTS from the TNC board is used to turn on the transistor, which grounds the rig's PTT, turning it on.

Since my packet board is used as a digital repeater on top of the AMRAD 147.81/21-MHz voice repeater, I had to detect when the repeater was already up (indicating that someone was using it on voice). The second half of the MC-1458 op amp is used as a voltage comparator, with one input coming from the rig's meter circuit, and the other input coming from a pot that determined the slicing level of the comparator. When there is no rf carrier, the pot is adjusted for a low on the output of the op amp (pin 1). When a signal is present, the output should change to a high. I fed this signal into the DSR input of the TNC board, and modified the software slightly to sample DSR. This is an option that most people won't implement, but I included it for reference.

HDLC Addressing

Chuck Green, NOADI brought up some ideas regarding my HDLC addressing scheme. Chuck's comments appear in the TAPR column of this issue. First, I must confess that I had a peek at the TAPR column when it arrived, allowing me to react in this issue. Lest this be considered unfair advantage, we are changing the delivery of the newsletter for the TAPR column writers to first class mail. That won't make for equal time this round but will make it possible for them to comment in the next issue. →

I would like to comment on Chuck's idea regarding the use of repeater bits. At first glance it would appear that using one bit as he suggests would work nicely. A problem occurs when the repeated packet is received by the intended destination. He looks at the repeat bit, sees that it is off, assumes that the packet has come directly from the sender, and tries to send his packets back that way. If he is far enough away from the other station, that station won't see his packets, and a connection will never be made. I think we will need both bits as they are being used now. This system has been in use for a while now, and it appears to be working fine. The one thing that I suggest that we add to the software is a routine to detect the repeated bit on a connection request, and automatically set it before responding.

Using the present single byte addressing scheme, this leaves six bits for actual addressing. Subtracting two addresses (we can't assign addresses 00 or FF hex) from the 64 possible, this leaves us with only 62 possible addresses. While this might be enough in a rural area, almost any city will surely use these up quickly.

The repeat bits shouldn't be put in the control field, there just isn't enough room if we are going to adhere to any of the standards presently being used. I propose that we force the letters of the amateur call in the address field to upper case, which uses 5 bits per character. If we assign the request-to-repeat bit to the first octet of the address, and the has been repeated bit to the second octet, there is more than enough room. This would also allow us up to 5 other bits (one spare bit per octet) for future expansion.

Chuck has put a lot of time into his protocol, figuring out the various problems dealing with dynamic addressing. I think he has thought out most of the collisions that might happen, and has worked around them. It does appear that he is demanding an awful lot of overhead in each node, since they all must be capable of being network controllers. This could add up to a large system if he must take control of a heavily ladden network.

I have mentioned in another article in this newsletter that I think we should look at following what the computer network people are doing. The capability of multi-party connections should be handled at the network level, not at the link level. If we use X.25, which I recommend, it allows for sixteen groups of up to 255 users per group. We could pre-agree that certain groups would be set aside for emergency communications, other groups for general hamming, etc. This takes care of network level addressing at the network level, while the link level connections are maintained at the link level.

The TAPR protocol, as I have seen it, actually uses five octets (bytes) in the address field, and two octets in the control field, adding up to seven octets. If we follow ADCCP and extend the address field as described in March, the equivalent amount used is six octets. Granted, these six octets don't have any network-level information, which takes up some of the data field (X.25 usually adds three octets once a virtual circuit is set up). The TAPR puts a lot of the levels two thru four overhead in the link level header. Not only does this complicate the link level, it restricts the possibilities of future expansion of the higher levels. This system also requires the changing of any level to affect drastically the other levels involved, one reason why most networks are seperated into different levels in the first place.

It appears that the TAPR protocol will work, but will have major problems latter on in the larger cities.

Another thing I must point out that is coming up sooner than I realized is that using the call sign approach will allow a user to move around several networks freely without having to worry about addresses each time. Even if he moves from a local 2-meter network to an hf link with a buddy three thousand miles away, the address won't change.

I have received several comments regarding my HDLC addressing scheme. Although it is a small sample, it is interesting to note that the responses from people in the computer network industry are favorable, while amateurs with other backgrounds seem to be against it. I should also point out that some in the industry are finding out that the single-octet address field is insufficient and are looking into extending it.

With AMSAT putting up Phase III-B soon, this adds another potential packet channel to the pile, with it's own peculiarities. Each of these channels (hf, vhf/uhf, and satellite) will have its own problems associated with it, probably leading to several permutations at the link level. If we put a lot of higher-level overhead in the link header, we add complexity that will be hard to work around when optimising the link-level protocol for the different rf media used.

Well, I have rambled on enough for this month, I hope that Dave will be back next month, so I can continue on the total network architecture that I envision.

□

AMRAD Amateur Radio Research and Development Corporation

Membership Application/Renewal

Mail to: Dr. William P. Pala, WB4NFB
5829 Parakeet Drive
Burke, VA 22015

See reverse for overseas mailing rates.

	Annual	Life
Dues: Regular	$15	$180
2nd in family same adr	8	96
Full-time student	5	-

Please make checks payable to AMRAD.

Name _____
Ham Call _____ Home Phone( ) _____

Address _____
City, State/Prov _____ ZIP/PC _____

Class License _____ □ARRL Member

Interests:
□Packet Radio □Spread Spectrum
□RTTY □Deaf TTY

Computer model _____
Microprocessor type _____

I agree to support the purposes of the Corporation.

Signature _____

THE AMATEUR RADIO RESEARCH AND DEVELOPMENT CORPORATION is a technically oriented club of over 500 radio and computer amateurs. It is incorporated in the Commonwealth of Virginia and is recognized by the Internal Revenue Service as a tax-exempt scientific and educational organization.

THE PURPOSES OF THE CLUB are to: develop skills and knowledge in radio and electronic technology; advocate design of experimental equipment and techniques; promote basic and applied research; organize forums and technical symposiums; collect and disseminate technical information; and, provide experimental repeaters.

MEETINGS ARE ON 1st MONDAY of each month at 7:30 p.m. at the Patrick Henry Branch Library, 101 Maple Ave E, Vienna, VA. If the 1st Monday is a holiday, an alternate date will be announced in the *AMRAD Newsletter*. Except for the annual meeting in December, meetings are normally reserved for technical talks - not business.

THE WD4IWG/R REPEATER is an open repeater for data communications (including RTTY), voice and experimental modes. It is located at Tyson's Corner, McLean, VA and has excellent coverage. It features a semi-private autopatch available to licensed members. Frequencies are: 147.81 MHz input, 147.21 MHz output. The head of the technical committee is Jeff Brennan, WB4WLW, 7817 Bristow Dr, Annandale, VA 22003, phone 703-354-8541.

THE AMRAD NEWSLETTER is mailed monthly to members and other clubs on an exchange basis. Technical articles, product announcements, news items, and other copy related to amateur radio and computing are welcom. Honorariums at a rate of $10 per printed page ($20 maximum per author per issue) are paid for original material accepted, Classified ads are free to members. Commercial ad inquiries are invited. The editor reserves the right to reject or edit any portions of the copy. Items should be mailed by the 8th of the preceeding month to Paul L. Rinaldo, W4RI, Editor, 1524 Springvale Ave., McLean, VA 22101, 703-356-8918. Full permission for reprinting or quoting items in the newsletter is granted provided that credit is given to both the author and the newsletter. Mailing to U.S. and possessions is by 3rd Class bulk mail. Canadian/Mexican addresses add $2 for postage. Overseas readers add $8 for air mail or $2.30 for surface.

THE AMRAD MESSAGE SYSTEM is an S-100 Computerized Bulletin Board System on 703-734-1387, system operator Terry Fox, WB4JFI. Terry's home phone number is 703-356-8334. The system accepts 110, 300, 450 and 600 baud ASCII callers using Bell 103-compatible modems.

THE HANDICAPPED EDUCATION EXCHANGE (HEX) is operated by AMRAD for those involved in education and communications for the handicapped. It accepts both 110/300-baud ASCII and deaf TTY callers. on 301-593-7033. The sysop Dick Barth, W3HWN's home phone is 301-681-7372.

AMRAD OFFICERS for 1982 are:

Gerald Adkins, N4GA	Treasurer
Richard Barth, W3HWN	Alternate HEX Sysop
David W. Borden, K8MMO	Alternate
Jeffrey Brennan, WB4WLW	Director Repeater Trustee
Robert E. Bruninga, WB4APR	VP Asia
Terry Fox, WB4JFI	Director Vice Pres CBBS Sysop
William Pala, Jr., WB4NFB	Director Secretary
Tedd Riggs, KC4YN	Librarian
Paul L. Rinaldo, W4RI	Director President Editor
Elton A. Sanders, WB5MMB	Director

THE AMRAD LIBRARY is operated by Tedd Riggs, KC4YN, 8402 Berea Ct, Vienna, VA 22180, phone 703-573-5067. Donations of technical books, magazines, manuals and catalogs are tax-deductible.

AMRAD IS AFFILIATED with the American Radio Relay League (ARRL), the Foundation for Amateur Radio (FAR), the Northern Virginia Radio Council (NOVARC), and The Mid Atlantic Repeater Council (T-MARC).

SPECIAL INTEREST GROUPS are formed as needed. Currently we have SIGs on Deaf Telecommunications, Spread Spectrum and Packet Radio. If you are interested in joining or forming a SIG, please contact Bill Pala, WB4NFB, 5829 Parakeet Dr, Burke, VA 22015, 703-323-8345.

AMATEUR RADIO RESEARCH AND
DEVELOPMENT CORPORATION
1524 SPRINGVALE AVENUE
MCLEAN, VA USA 22101

Nonprofit Organization
U.S. Postage
PAID
McLean, Virginia 22101
Permit No. 1511

11/82 M
HOWARD L. NURSE W6LLO
665 MAYBELL AVE
PALO ALTO CA 94306